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**Canada-Manitoba Agreement
on the
Study and Monitoring of Mercury
in the
Churchill River Diversion**

CANADA-MANITOBA
AGREEMENT ON THE STUDY AND MONITORING OF
MERCURY IN THE CHURCHILL RIVER DIVERSION

ANNUAL REPORT
FOR
THE PERIOD
April 1, 1982 to March 31, 1983

April 1, 1984

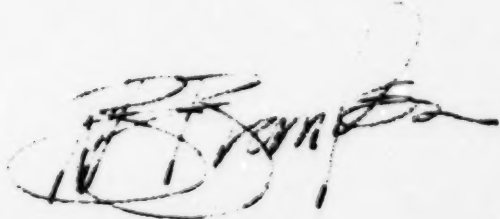
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Gentlemen:

I am pleased to present the first Annual Report of the
Canada-Manitoba Agreement on the Study and Monitoring of Mercury in
the Churchill River Diversion, signed March 10, 1983, with provisions
retroactive to April 1, 1982.

This report is divided into five major components; Summary,
Introduction, Agreement Management, Financial Arrangements, and
Project Activities - 1982/83.



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SOMMAIRE

Voici le premier rapport annuel de l'accord Canada-Manitoba pour l'étude et la surveillance du mercure dans le réseau de dérivation de la rivière Churchill. L'accord a été signé le 10 mars 1983 et comporte des dispositions à effet rétroactif au 1^{er} avril 1982. Un des objectifs de l'accord consiste à "accroître (notre) connaissance du problème de la contamination par le mercure dans le nord du Manitoba et (notre) capacité de prendre des mesures correctives".

Le mercure existait déjà au tout début des temps à l'intérieur de la terre. Au cours des millions d'années qui se sont écoulées depuis, il a traversé l'écorce terrestre pour apparaître dans les rochers, le sol, l'eau, l'air et les ORGANISMES¹ vivants. Ce type de mercure relativement inoffensif peut se changer en poison (appelé MÉTHYL-MERCURE) sous l'effet des petits organismes qui se trouvent dans l'eau et les sédiments. Les conséquences de l'introduction et de l'accumulation de méthyl-mercure dans le poisson par l'intermédiaire de la chaîne alimentaire aquatique sont nombreuses dans le nord du Manitoba. Elles comprennent la fermeture de lacs à la pêche commerciale, la perte de revenu due à la baisse de la consommation nationale et des exportations de poisson contaminé, la disparition de sources locales de nourriture et l'apparition possible de problèmes de santé chez l'être humain.

L'administration de l'accord incombe aux quatre membres du Comité directeur. Les deux membres fédéraux et les deux membres provinciaux de ce comité ont été nommés en mars 1983. Le co-président fédéral et le co-président provincial remplissent à tour de rôle les fonctions de président et se relaient annuellement. L'accord comprend quatorze projets. Les activités de onze de ces projets sont à frais partagés, conformément à l'accord. Sur ces onze projets, six devaient être mis en oeuvre en 1982-1983.

Dans le cas de deux projets (projet 1.3, Mobilisation et méthylation et projet 2.2, Processus d'accumulation biologique), tous les travaux sur le terrain se sont terminés en mars 1983. On a aussi réalisé des progrès satisfaisants dans le cas de deux autres projets à frais partagés: le projet 2.1, Écosystèmes expérimentaux et le projet 3.3, Relevés des poissons et guide de consommation.

Le projet 4.1, Sensibilisation du public et le projet 4.2, Coordination et gestion des études ne pouvaient être mis en oeuvre qu'après la signature de l'accord. Par conséquent, les progrès réalisés au 31 mars 1982 sont limités. Les principales activités entreprises se résument, dans le cas du premier, à un communiqué de presse publié le 10 mars 1983 et, dans le cas du second, à la mise en marche du processus de dotation du poste de directeur des études.

¹ Dans ce rapport, chaque fois qu'un mot "technique" apparaît pour la première fois, il sera dactylographié en lettres majuscules. La définition de ces mots "techniques" figure dans le glossaire qui se trouve en fin de rapport.

La signature tardive de l'accord a été la cause d'une grande incertitude au sujet du financement, dans le cadre de l'accord, de tout projet mis en oeuvre en 1982-1983. En dépit de cette incertitude, les engagements financiers des deux parties à l'endroit des projets figurant dans l'accord se sont chiffrés à 147 109,28 \$, sur un budget total de 175 000 \$. Vu qu'il s'agissait de la première année de l'accord, la plus grande partie des activités de 1982-1983 se sont composées de travaux sur le terrain et d'analyses d'échantillons.

On peut obtenir certains résultats préliminaires dans le cas des projets entrepris par le ministère des Pêches et des Océans. Le projet 1.3 a permis de découvrir qu'il n'existait pas de variations régionales de concentration naturelle de mercure dans les échantillons provenant de sols non inondés et que les concentrations de mercure dans les poissons étaient généralement plus élevées dans les échantillons prélevés dans les endroits inondés. On a aussi découvert qu'il y avait peu de rapports importants entre les niveaux de concentration de mercure dans les poissons et les paramètres LIMNOLOGIQUES, exception faite de la température et de la concentration de mercure dans les ZOOPLANKTONS les plus grands. En ce qui a trait au projet 2.1, on a découvert que les terres inondées (mousses et tourbes) constituent un excellent SUBSTRAT pour méthyler les bactéries, de sorte que la MÉTHYLATION du mercure se trouve stimulée par les eaux captées. On a aussi découvert que l'efficacité des terrains inondés sur la méthylation du mercure diminue avec le temps. Dans le cadre du projet 3.3, on a comparé les résultats obtenus en 1978-1981 avec ceux de 1982 aux postes d'échantillonnage du lac Sud des Indiens et du lac Issett; cette comparaison semble indiquer que les concentrations de mercure tendent à baisser dans le corégone, à augmenter dans le brochet et à se maintenir au même niveau dans le doré.

Les trois derniers projets de l'accord font partie des programmes internes ordinaires des ministères fédéral et provincial, et ne sont pas financés dans le cadre de l'accord. Ces trois projets - projet 1.1, Mercure dans l'eau et les sédiments; projet 3.2, Envois commerciaux de poissons; et projet 3.4, Mercure dans les cheveux des autochtones - sont néanmoins inclus dans l'accord vu que leur exécution et leurs résultats s'apparentent de près aux objectifs de l'accord. Ces trois projets étaient opérationnels en 1982-1983.

En 1983-1984, on compte poursuivre les travaux visant à définir l'effet des substrats organiques, séparément et en combinaison avec d'autres, sur la BIOACCUMULATION du mercure (projet 2.1). On étendra l'analyse des concentrations de mercure dans les poissons à d'autres régions en prélevant des échantillons dans d'autres lacs, tels que Threepoint et Split ainsi que le lac Sud des Indiens et le lac Issett (projet 3.3). Le projet 2.3, Caractéristiques biochimiques et géochimiques des sédiments et le projet 2.4, Relevés limnologiques seront tous deux mis en oeuvre en 1983-1984. On concentrera plus d'effort sur le projet 4.1, Sensibilisation du public.

SUMMARY

This is the first annual report for the Canada-Manitoba Agreement on the Study and Monitoring of Mercury in the Churchill River Diversion. The Agreement was signed on March 10, 1983, with provisions in the Agreement retroactive to April 1, 1982. One of the purposes of the Agreement is to improve our "knowledge and ability to respond to mercury problems in northern Manitoba".

Mercury has been in the environment since the beginning of time. During the passage of millions of years it has worked its way through the earth's surface appearing in rocks, soil, water, air, and living ORGANISMS¹. This relatively harmless form of mercury may be changed to a poisonous form called METHYL MERCURY by MICROBES in the water and sediments. The ramifications of the introduction and accumulation of methyl mercury in fish through the aquatic food chain in northern Manitoba are many. They include closure of lakes for commercial fishing, loss of income due to reduced domestic and export markets for contaminated fish, loss of local food sources, and potential human health problems.

The management of the Agreement is under the direction of a four member Steering Committee. The two federal and two provincial members of this committee were officially appointed in March, 1983. One federal co-chairman and one provincial co-chairman rotate the duties of chairmanship on an annual basis.

The Agreement consists of fourteen projects. Eleven of the fourteen projects are funded as cost-shared activities under the Agreement. Of these eleven, six were scheduled to be underway in 1982/83.

All of the field work for two of these projects - Project 1.3, Mobilization and Methylation and Project 2.2, Bio-Accumulation Processes - was completed by March 1983. Good progress was also made on two other cost-shared projects - Project 2.1, Experimental Ecosystems and Project 3.3, Fish Surveys and Fish Eating Guide.

Project 4.1, Public Awareness, and Project 4.2, Study Coordination and Management, could only begin after the signing of the Agreement. As a result, only limited progress was made on them by March 31, 1983. The principal activities were a news release made on March 10, 1983, and the initiation of staffing procedures for the hiring of a Study Director, respectively.

1 Throughout this report, whenever a "technical" word appears for the first time, it will appear in capital letters. The meaning of these "technical" words will be found in the glossary at the end of this report.

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The late signing of the Agreement created considerable uncertainty regarding whether any projects undertaken in 1982/83 would be funded under the Agreement. Despite this uncertainty the parties' commitment to the Agreement projects still amounted to \$147,109.28 out of a budget of \$175,000. Being the first year of the Agreement most of the activity in 1982/83 was related to field work and analysis of samples.

Some preliminary results from those projects undertaken by the Department of Fisheries and Oceans are available. Under Project 1.3, it was found that there were no regional variations in the natural concentrations of mercury in the unflooded soils sampled, and that fish mercury levels were generally higher at the sampled flooded sites. There were also few significant relationships between fish mercury levels and LIMNOLOGICAL parameters with the exception of temperature and the mercury content of the largest ZOOPLANKTON fraction. Under Project 2.1, it was found that flooded ground cover (moss and peat) is an excellent SUBSTRATE for methylating bacteria, and mercury METHYLATION is thus stimulated by impoundment. It was also found that the effectiveness of flooded ground cover in methylating mercury declines with time. Under Project 3.3, a comparison of 1982 results with 1978-81 results, from sites in Southern Indian Lake and Issett Lake, suggests a continuing trend of decreasing mercury levels in whitefish, continuing trend of increasing mercury levels in pike, and that mercury levels in walleye have been relatively stable.

The remaining three projects of the Agreement are part of ongoing internal federal and provincial departmental programs which are not funded under the Agreement. These three projects - Project 1.1, Mercury in Water and Sediments; Project 3.2, Commercial Fish Surveys; and Project 3.4, Mercury in Hair of Native People - are included in the Agreement because their implementation and results are so closely related to the Agreement's objectives. All three projects were active in 1982/83.

For 1983/84, it is anticipated that work will continue on defining the effect of organic substrates, both singly and in combination, on the BIOACCUMULATION of mercury (Project 2.1). The geographic area for the analysis of mercury levels in fish will be expanded by sampling a number of other lakes such as Threepoint and Split, as well as Southern Indian Lake and Issett Lake (Project 3.3). Project 2.3, Biogeochemistry of Sediments and Project 2.4, Limnological Survey will both commence in 1983/84. Increased effort will be directed towards Project 4.1, Public Awareness.

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GLOSSARY

CHAPTER 1. INTRODUCTION

The Canada-Manitoba Agreement on the Study and Monitoring of Mercury in the Churchill River Diversion, (subsequently referred to as the Agreement), was signed on March 10, 1983. The study area of the Agreement is part of an area of northern Manitoba which has been experiencing a period of rapid change in the last two decades. The catalyst for this change is the hydroelectric development of the Churchill and Nelson Rivers. In order to put the Agreement into its proper perspective, it is necessary to briefly outline the major events which have resulted from this hydroelectric development. This will be followed by a summary of the events leading to signing of the Agreement, a description of the Agreement, and of the individual Agreement projects.

1.1. Churchill-Nelson Rivers Hydroelectric Development Project

In 1966, the Government of Manitoba, through Manitoba Hydro, decided to proceed with developments to harness the potential energy of the Nelson River and to add to that potential by diverting a major part of the Churchill River flow into the Nelson River. This hydroelectric development impacts on thousands of hectares of land, lakes, rivers, and streams through water control structures, such as dams, and hydro generating stations in northern Manitoba. The governments of Manitoba and Canada recognized that this project would have widespread and long-lasting effects on the socio-economic and environmental conditions of the affected region.

In 1971, the two governments signed the Canada-Manitoba Study Agreement for Lake Winnipeg and the Churchill and Nelson Rivers. The objective of this study was "to determine the effects that regulation of Lake Winnipeg, diversion from the Churchill River and development of hydroelectric potential of the Churchill River diversion route are likely to have on other water and related resource uses and to make recommendations for enhancing the overall benefits with due consideration for the protection of the environment". Of the forty-seven recommendations made when the study was completed in 1975, two are particularly relevant here. Recommendation #4 states "that a special appeal mechanism be established to which unresolved compensation issues can be referred for adjudication". Recommendation #10 states "that appropriate government departments and agencies develop and implement a long-term coordinated ecological monitoring and research program to allow impact evaluation and to assist in the ongoing management of the affected area."

There are five major treaty Indian bands located within the area affected by the hydroelectric project - Cross Lake Indian Band, Nelson House Indian Band, Norway House Indian Band, Split Lake Indian Band and York Factory Indian Band. In 1974 these bands established the

Northern Flood Committee to represent their common, and, where appropriate, specific political, legal, social and economic interests with respect to the above mentioned hydroelectric development program.

In 1976 impoundment of Southern Indian Lake occurred, raising the water level of the lake by three meters above its long-term mean level, in order to divert the Churchill River into the Nelson River basin to augment the hydroelectric power production.

In 1977 the Northern Flood Agreement was signed by four parties; the Government of Manitoba, Manitoba Hydro, the Northern Flood Committee, and the Government of Canada. This was a landmark agreement, almost without precedent in Canada. In essence, the objective of this agreement is to ensure that all persons who may be or have been directly or indirectly adversely affected by the hydroelectric development project shall be dealt with fairly and equitably. An extremely important article in this agreement is Article 24. This article establishes an arbitration mechanism and the appointment of an arbitrator who ".... shall have broad authority and power to make awards capable of implementation and to fashion an appropriate and just remedy in respect of any and all adverse effects of the project on any person".

In 1980, an arbitrator was appointed. He is Judge P. D. Ferg, from the Manitoba Court of Appeals.

In April 1981, claim #12 was filed under the Northern Flood Agreement. The points of claim included:

1. recording levels of mercury in water, sediments and fish at specific points throughout the river systems sufficient for the determination of adverse effects of the (hydroelectric) Project;
2. undertaking research programs for the purpose of mitigating or remedying the adverse effects of mercury contamination;
3. providing dietary advice and medical services to reduce adverse effects of mercury poisoning; and
4. providing compensation for losses due to mercury poisoning.

In June 1981, Judge Ferg issued an interim order for this claim. Paragraphs 26, 27 and 28 directed Canada and Manitoba to formulate a plan to study and monitor mercury in the area affected by the hydroelectric development project and to indicate how and when it would be implemented. This plan is to include ascertaining the levels of mercury in the aquatic environment of this area, the source of any increased levels in fish and people, the mechanism by which mercury enters the food chain, and evaluating the effectiveness of any potential remedial or mitigating measures.

1.2 Events Leading up to The Signing of the Agreement

In 1969/70, the Industry Services Branch, Department of Fisheries and Oceans, established a lake classification system whereby lakes are classified on the basis of the mercury levels of the fish taken from each lake. All lakes which produce fish for commercial marketing in Manitoba, including those in the Agreement study area, are monitored to determine the risk of exceeding the tolerances of the various countries to which the fish may be marketed. In Canada the tolerance level for mercury in fish is 0.5 ppm; in some other countries, such as the United States of America, it is 1.0 ppm.

Over the period 1974-78 the majority of the flow of the Churchill River was diverted into the Nelson River Basin through a chain of lake and river sections known as the Rat-Burntwood system. In 1977/78 commercial fishing began in the lakes of the Burntwood-Rat System - Notigi, Rat, Mynarski, Wapisi and Issett Lakes. In the regular monitoring which accompanied the commercial fishing, levels of mercury in the PREDATORY fish in the Rat-Burntwood system were found to be as high as 2.0 ppm. Commercial fishing in this system was then prohibited by the provincial government. At the same time, fish in the South Bay Area of Southern Indian Lake were found to have higher mercury levels than before impoundment. However fishing in Southern Indian Lake was not prohibited. The mercury levels in the whitefish populations were low enough to permit them to be marketed both within and outside of Canada. The predatory fish from Southern Indian Lake however could only be marketed in countries such as the U.S.A. where the acceptable mercury level for fish is 1.0 ppm.

In 1978 and 1979 a series of discussions took place between Canada and Manitoba, in particular between their departments of environment. There was concern over the possibility of post-impoundment increases in the mercury levels of fish in the impacted areas.

In October 1979 a federal-provincial seminar was held in Winnipeg to discuss mercury in the environment of the Churchill-Nelson Diversion. A large number of federal and provincial departments were represented at this day long seminar. Some of the basic questions which the seminar addressed were:

1. Is there a problem with mercury in the environment of the Churchill-Nelson Diversion?
2. If there is a problem, what is the relationship of the problem to the hydro-electric development project in the area?
3. What additional studies are required to answer the outstanding questions?
4. What resources are required to carry out these studies?

The seminar's conclusions were that more information was required to answer the many questions raised.

In 1980, negotiations proceeded towards the drafting of a federal-provincial agreement to study and monitor mercury in the Churchill River Diversion area. The negotiations included the determination of the objectives of the Agreement and how best to realize them. It also included the determination of the total budget and how it was to be cost-shared. By 1981, when claim #12 was filed under the Northern Flood Agreement, the federal-provincial negotiations had resulted in the fifth draft of the Agreement.

By 1982, negotiations were in the final stages with the signing of the Agreement imminent. As a result some of the participating departments increased their research activities in the Churchill River Diversion area. During this period negotiations and coordination were facilitated by an Ad Hoc Steering Committee appointed by the two governments. The Agreement was formally signed on March 10, 1983, with the provisions of the Agreement retroactive to April 1, 1982.

1.3 The Agreement

The Canada-Manitoba Agreement on the Study and Monitoring of Mercury in the Churchill River Diversion was signed by the Honourable John Roberts, Minister, Environment Canada and by the Honourable Jay Cowan, Minister, Environment and Workplace Safety and Health.

The objectives of the Agreement are:

- (a) to further investigate mercury levels in water, sediments, and the aquatic food chains along the Churchill-Nelson Rivers Diversion route (including if possible, comparison with levels in a similar water body in northern Manitoba which has not received inorganic mercury loading as a result of human activity, and has not been subject to diversion);
- (b) to determine the source(s) of mercury input to the diversion system;
- (c) to research the mechanism(s) whereby the mercury is released and enters the food chains;
- (d) to assess the significance of these phenomena to future water management activities; and
- (e) to advise the public of the purpose, progress, and results of studies undertaken.

The Agreement, scheduled to terminate on March 31, 1986, has a total budget of seven hundred and sixty thousand dollars (\$760,000). The federal and provincial governments contribute equally to the eligible costs incurred under the Agreement. The maximum contribution by

either Manitoba or Canada is not to exceed three hundred and eighty thousand dollars (\$380,000). The Canada Water Act which is administered by Environment Canada is the mechanism used to provide the federal funding under the Agreement. The provincial funds are provided through the Department of Environment and Workplace Safety and Health. The Manitoba Department of Finance is responsible for the financial co-ordination of expenditures relating to the Agreement.

The main study area of the Agreement is the Churchill River Diversion system. However for purposes of scientific control, other similar water bodies in northern Manitoba which have not received inorganic mercury loadings as a result of human activity and have not been subject to diversion are also studied under some projects of the Agreement.

The Agreement is divided into four major programs; Research and Monitoring of Source Mercury and Mobilization into Aquatic Food Chains; Research and Monitoring of Mercury Bio-Accumulation by Aquatic Food Chains; Research and Monitoring of Mercury Levels in Fish and Animals and Human Consequences; and Information and Management. These four programs are divided into a total of fourteen projects. Eleven of these projects are cost-shared under the Agreement. The other three projects are part of ongoing departmental programs. They are included in the Agreement for information purposes since their implementation and results are so closely related to the objectives of the Agreement.

1.4 Agreement Programs and Projects

The research and monitoring programs under the Agreement have been designed to determine the degree to which mercury is present in the Churchill River Diversion system, its source, the pathways and mechanisms involved in the movement and concentration of mercury in ECOSYSTEMS, and the effects that such mercury may have on the people of the area. It is further intended through these studies, if possible, to suggest practical remedies to local mercury problems and to develop means of predicting the duration and future occurrences of such problems. Specifically these programs will investigate the processes by which mercury is mobilized from natural or ANTHROPOGENIC sources, bioaccumulated through the food chain to fish and other animals, and ultimately consumed by humans.

In this part of the annual report, the purpose of each program and the objective of each project is given. Table 1 shows the total Agreement budget, the time frame for implementation, and the department(s) with the responsibility for the implementation for each project. The progress made in 1982/83 on each project will be discussed in Chapter 4 of this report.

1.4.1 Program 1: The purpose of Program 1 is to obtain a better understanding of the ultimate source of the mercury contamination in the Churchill River Diversion area. This program is subdivided into three projects.

The objective of Project 1.1 is to determine the existing levels of mercury in the water and sediments along the diversion route and other comparable areas of northern Manitoba. The objective of Project 1.2 is to conduct a material balance to approximate distribution and destination of mercury in the northern Manitoba environment. The objective of Project 1.3 is to determine the degree to which naturally occurring MERCURIALS are METHYLATED after lake impoundment, and the degree to which local conditions affect the mercury content of BIOTA, particularly FORAGE fish.

1.4.2 Program 2: The purpose of Program 2 is to obtain a better understanding of the pathways of bioaccumulation of mercury through the aquatic food chains. This program is subdivided into four projects.

The objective of Project 2.1 is to study the effects of changes associated with lake impoundment on the bioaccumulation of mercury. The objective of Project 2.2 is to determine the mechanisms of mercury transfer between the bottom sediment reservoir and the fish population. The objective of Project 2.3 is to relate the mercury accumulation in fish and other organisms to the different forms of mercury, sources, and environmental conditions. The objective of Project 2.4 is to determine if the aquatic ECOLOGY of the impounded areas has achieved a new steady state or if the affected areas are still in rapid transition.

1.4.3. Program 3: The purpose of Program 3 is to obtain a better understanding of the consequences of the elevated fish mercury levels to the people living along the Churchill River Diversion system. This program is subdivided into four projects.

The objective of Project 3.1 is to determine whether there is mercury accumulation further along the food chain and if such accumulation is verified to determine its geographic extent. The objective of Project 3.2 is to monitor the mercury levels in commercial fish shipments from the Agreement study area to determine the risk of exceeding the mercury tolerance levels of the various countries (including Canada) in which the fish may be marketed. The objective of Project 3.3 is to sample several species of fish for mercury analysis from selected areas (in the Churchill River Diversion system, in areas where the residents of the communities along the Diversion system fish for domestic consumption, and in other lakes in northern Manitoba not connected to the Diversion system). The objective of Project 3.4 is

to obtain information on the mercury levels, from blood and hair analysis, of the people in the communities along the Churchill River Diversion system. Health education, such as dietary advice on how to keep their mercury levels within acceptable limits, and continuing surveillance, such as neurological testing, is also provided as required to the people of these communities.

1.4.4 Program 4: The purpose of Program 4 is twofold:

1. to ensure that any person who stands to be directly affected by any mercury problems in the Agreement study area, and the public at large is informed about all aspects of the Agreement; and
2. to provide coordination and management throughout the duration of the Agreement.

This program is subdivided into three projects. The objective of Project 4.1 is to advise the public of the purpose, progress and results of the studies undertaken under the Agreement. A second objective is to obtain feedback about the Agreement from the people in the communities along the Churchill River Diversion system. The objective of Project 4.2 is to provide close coordination of the various studies while they are proceeding and integration of the resulting information as it becomes available, including the compilation of data generated from the non cost-shared projects under the Agreement. The objective of Project 4.3 is to prepare annual reports and a final report which will constitute the report to the Ministers.

TABLE 1: AGREEMENT BUDGET, TIME FRAME AND RESPONSIBLE DEPARTMENT, BY PROJECT

<u>Project Number</u>	<u>Total Agreement Budget</u>	<u>Time Frame</u>	<u>Responsible Department</u>
1.1	-	-	EMD
1.2	100,000	84/85-85/86	EMD DOE
1.3	40,000	82/83	DFO
2.1	60,000	82/83-84/85	DFO
2.2	42,000	82/83	DOE
2.3	40,000	83/84-84/85	DOE
2.4	160,000	83/84-85/86	DFO
3.1	30,000	84/85-85/86	EMD NR DOE
3.2	-	-	DFO
3.3	173,000	82/83-85/86	NR DFO
3.4	-	-	NHW DH
4.1	25,000	82/83-85/86	EMD NA DINA
4.2	60,000	82/83-85/86	EMD DOE
4.3	30,000	85/86	EMD DOE

Note:

Responsible Department

EMD Manitoba Environmental Management Division
 NR Manitoba Department of Natural Resources
 NA Manitoba Department of Northern Affairs
 DH Manitoba Department of Health
 DOE Canada Department of Environment
 DFO Canada Department of Fisheries and Oceans
 DINA Canada Department of Indian and Northern Affairs
 NHW Canada Department of National Health and Welfare

CHAPTER 2: AGREEMENT MANAGEMENT

2.1 Agreement Structure

Section 3 of the Agreement specifies that a four member Steering Committee be appointed by the federal Minister responsible for the Department of the Environment and the provincial Minister responsible for the Environmental Management Division. The two federal members are to be selected from the Department of the Environment (federal co-chairperson) and the Department of Fisheries and Oceans. Both provincial members are to be selected from the Environmental Management Division. Chairpersonship will alternate between Canada and Manitoba on a yearly basis.

The duties of the Steering Committee include the following:

1. ensuring that the objectives and the intent of the terms and conditions of the Agreement are carried out;
2. approving an annual budget and work plan for proposed programs and projects;
3. transferring funds from one project to another where appropriate and consistent with the intent of the Agreement;
4. recommending to the Ministers any changes to the Agreement;
5. selecting a Study Director and approving the duties of that position;
6. establishing technical subcommittees as required;
7. establishing standards and procedures for the approval and efficient implementation of projects;
8. providing a progress report to the Ministers at the end of each fiscal year;
9. providing a final report for presentation to and public release by, the Ministers within six months of the termination date of the Agreement.

As noted above, a Study Director is to be selected by the Steering Committee. In general, the Study Director will be responsible for the close coordination of the various studies while they are proceeding and integration of the resulting information as it becomes available. Under subsection 3(6)(e) of the Agreement, the Province, will contract with an individual to be the Study Director, whose coordination and management duties will be approved by the Steering Committee. This individual will also be actively involved in Project 4.1 (Public Awareness).

Technical subcommittees may be established by the Steering Committee. The Steering Committee may request representatives to the technical subcommittees from any government department or agency or any non-governmental body. In general, the purpose of the technical subcommittees is to provide advice to the Steering Committee on the scientific merit and technical viability of proposed activities under the Agreement and to evaluate the progress of ongoing activities.

2.2 Progress

As noted previously, the Agreement was formally signed on March 10, 1983 with the provisions of the Agreement retroactive to April 1, 1982. In March 1983, the members of the Steering Committee were formally appointed by their respective Ministers. The members are as follows:

CANADA

Mr. D. R. Kimmett (Co-Chairperson),
Regional Chief,
Water Resources Branch,
Inland Waters Directorate,
Environment Canada,
521 Federal Building,
269 Main Street,
Winnipeg, Manitoba.
R3C 1B2

Mr. R. Josephson,
Director, Arctic Operations,
Fisheries and Oceans,
Western Region,
Freshwater Institute,
501 University Crescent,
Winnipeg, Manitoba.
R3T 2N6

MANITOBA

Mr. W. E. Brandson (Co-Chairperson),
Acting Director,
Environmental Management Services,
Environmental Management Division,
Environment and Workplace Safety and Health,
Building 2, Box 7,
139 Tuxedo Avenue,
Winnipeg, Manitoba.
R3N 0H6

Mr. M. Morelli,
Chief, Environmental Standards and Studies,
Environmental Management Division,
Environment and Workplace Safety and Health,
Building 2, Box 7,
139 Tuxedo Avenue,
Winnipeg, Manitoba.
R3N 0H6

From June 14, 1982 to March 23, 1983 the above-mentioned individuals met six times as an AD Hoc Steering Committee. A number of organizational matters were discussed during this time in anticipation of the signing of the Agreement.

The use of a Project Proposal form and a Project Authorization form for each project for each fiscal year was introduced. The Project Proposal provides basic information about each project such as; project objectives, general thrust of the research/survey project, findings to date, work plan, and budget. The Project Authorization form is essentially a one page summary of the Project Proposal. Once the latter form is dated and signed by all members of the Steering Committee, a commitment of funds has been made to that project and work can begin.

The Steering Committee decided to establish one Technical Advisory Committee. This committee will have the responsibility of advising the Steering Committee on the scientific value and technical viability of all projects undertaken under the auspices of the Agreement. The Technical Advisory Committee may also be requested, from time to time, to provide advice on administrative matters, such as the format of the project reports.

The Technical Advisory Committee will be composed of eight members, four from provincial departments and four from federal departments. The Study Director will be the chairperson of this committee. Terms of reference for this committee will be determined after a Study Director has been hired.

As of March 31, 1983 suggestions had been made regarding which federal and provincial departments should be represented on the Technical Advisory Committee. The formal nomination of all eight members to the Technical Advisory Committee should be completed by the end of April, 1983.

The Steering Committee had a number of discussions on the specific duties of the Study Director and on the mechanism required to hire an individual for this position. The Steering Committee identified the following key functions of this position:

1. directs the studies/programs under the Agreement;
2. maintains financial control over the projects;
3. co-ordinates public information;
4. acts as overall technical and managerial co-ordinator, within and between projects;
5. acts as a technical advisor to the Steering Committee; and
6. performs other related duties as assigned by the Steering Committee.

As of March 31, 1983, a job description had been approved by the Steering Committee, and arrangements were well under way to begin interviewing for this position.

CHAPTER 3. FINANCIAL ARRANGEMENTS

3.1 Financial Structure

Section 6 of the Agreement provides the details on the financial aspects of the Agreement. Most provisions contained within this section are standard provisions used in many federal-provincial agreements. Eligible costs are those defined by the Steering Committee as reasonably and properly incurred and paid by the implementing agency for the supply of goods, the performance of work, or the performance of services for the implementation of any such project. Ineligible costs are also defined and include legal fees, land acquisition, and the salary and travel costs of certain individuals.

There are subsections on the payment of costs, submission of claims, and the need to maintain adequate documentation and records of all incurred costs. There are also subsections on advance payments by Canada to assist with interim financing, if required, and on the period of time over which eligible costs may be incurred for payment under the Agreement.

3.2 Expenditures for 1982/83

Section 6(8)(a) authorizes payment of claims for work or services completed under the Agreement as long as such work or service had commenced on or after April 1, 1982. When the Agreement was signed on March 10, 1983, it then became possible to authorize payment of costs incurred by the five cost-shared projects which were initiated in 1982/83. Despite the short amount of time remaining in the fiscal year 1982/83, payment of the incurred costs proceeded smoothly since the Ad Hoc Steering Committee had completed all the required preparatory work including the review and preliminary approval of submitted claims.

Table 2 shows the total cost shared expenditures incurred under the Agreement in 1982/83.

TABLE 2: 1982/83 BUDGET AND EXPENDITURES, BY PROJECT

<u>Project Number</u>	<u>Total Agreement Project Budget</u>	<u>1982/83 Project Budget</u>	<u>1982/83 Expenditures</u>	<u>Total Agreement Funds Remaining</u>
1.2	100,000	-	-	100,000.00
1.3	40,000	40,000	38,069.01	1,930.99
2.1	60,000	30,000	29,540.27	30,459.73
2.2 ¹	42,000	42,000	29,423.62	-
2.3 ¹	40,000	-	12,576.38	40,000.00
2.4	160,000	-	-	160,000.00
3.1	30,000	-	-	30,000.00
3.3	173,000	53,000	37,500.00	135,500.00
4.1	25,000	5,000	-	25,000.00
4.2	60,000	5,000	-	60,000.00
4.3	30,000	-	-	30,000.00
Total	760,000	175,000	147,109.28 ²	612,890.72

NOTE: 1: The \$42,000 allocated to Project 2.2 in Schedule B of the Agreement was redirected by the Steering Committee to both Project 2.2. and Project 2.3.

2: There was an underexpenditure in 1982/83 of \$27,890.72.

CHAPTER 4: PROJECT ACTIVITIES - 1982/83

4.1 Introduction

Five cost-shared and three non cost-shared projects were undertaken in 1982/83. On March 23, 1983, a briefing session was held in which each project leader for a cost-shared project briefly outlined the activities and preliminary findings. The following sections summarize this information and similar information for the non cost-shared projects.

4.2 Program 1

4.2.1. Project 1.1. Mercury in Water and Sediments: This project is part of an ongoing provincial government program. In 1982/83, bottom sediments were collected in triplicate, once, and surface water samples were collected six times at twenty-seven sites north of the 53⁰ parallel. The location of these sites were as follows:

1. five sites on the Churchill River diversion route (Southern Indian Lake, Footprint Lake, Burntwood River at Thompson, Burntwood River at Apussigamasi Lake, and Split Lake).
2. two sites upstream of Southern Indian Lake (Churchil River at Granville Lake and Barrington River near Opachuanau Lake).
3. three sites on the Nelson River upstream of Split Lake (Little Playgreen Lake, Cross Lake, and Sipiwek Lake).
4. seventeen other sites at various locations.

The results of this year's activities along with those of 1980 and 1981, are in preparation in a technical report form. This report will be similar to that released in 1980, on the 1979 sampling program. That report is entitled "Heavy Metal Concentrations in Northern Manitoba Lake and River Sediments, August 1979" and is available from the Manitoba Environmental Management Division. The designated contact person for Project 1.1 is Mr. D. Williamson, Environmental Management Division.

4.2.2 Project 1.3. Mobilization and Methylation: This project actually began in 1981 with the field work concluded in 1982 - the first year of funding under the Agreement. In 1981 an initial survey of thirteen sites was conducted in and around the Churchill River diversion area and in 1982 seven selected sites, including two unflooded lakes, were surveyed.

The relationship between biota mercury content and background mercury content, any apparent depletion of soil mercury levels, and rates of mercury methylation were investigated. Analysis of the 1982 data

remains to be completed as well as the preparation of the project report. However, some preliminary results from the 1981 summer program are available:

1. There were no noticeable regional variations in natural concentrations of mercury in unflooded soils;
2. Fish mercury levels were generally higher at flooded sites;
3. Mercury levels in flooded A and clay soil horizons were not significantly lower than levels in unflooded soil horizons;
4. There were few significant relationships between fish mercury levels and limnological parameters with the exception of temperature and the mercury content of the largest zooplankton fraction;
5. Sediment mercury methylation rates were distinctly higher at Issett Lake, at the upper end of the Notigi reservoir, and were consistently low in Granville Lake, an unflooded site.

Dr. R. A. Bodaly and Dr. R. E. Hecky, both of the Department of Fisheries and Oceans, are the project leaders.

4.3 Program 2

4.3.1 Project 2.1 Experimental Ecosystems: Like Project 1.3, work actually began on Project 2.1 in 1981, with the establishment of seven experimental ecosystems (LIMNOCORRALS) in Long Bay, Southern Indian Lake. Additions of moss or clay or phosphorus and nitrogen were made to some of the limnocorrals and the results compared to those limnocorrals used as controls. Preliminary results indicated that the addition of moss had the most effect compared to the controls, both in terms of the rates of mercury methylation in the water and sediments and in terms of the bioaccumulation of mercury into fish.

In the summer of 1982, seven experimental ecosystems were established in Long Bay, Southern Indian Lake. This year's experiments focused on the effect of flooded moss and suspended sediments on mercury bioaccumulation. Of the seven limnocorrals, four were treated with various amounts and ages of flooded moss, one was established to study the effects of clay addition, and two were established as controls. Samples of fish were taken at two week intervals over the summer for the determination of radioactive mercury uptake. Rates of mercury methylation were determined over the summer and limnological conditions were monitored.

The preliminary interpretation of the 1982 experiments were as follows:

1. Flooded ground cover (moss and peat) is an excellent substrate for methylating bacteria and mercury methylation is thus stimulated by impoundment;
2. The effectiveness of flooded ground cover in methylating mercury declines with time;
3. Eroding glacial Lake Agassiz clay also stimulates mercury bioaccumulation by covering the natural lake sediment (bottom material for controls). Laboratory experiments confirmed that Agassiz clays removed $^{203}\text{Hg}^{2+}$ (a radioactive form of mercury) from solution less rapidly than lake sediment and bound it less strongly.

This project is directed by Dr. R. E. Hecky, Department of Fisheries and Oceans.

4.3.2 Project 2.2, Bioaccumulation Processes: Activity under Project 2.2 began in 1981 with an abbreviated sampling program. Biological samples were collected from six sites representing the range of basic sediment-deposition conditions in the areas of study in the Churchill-Nelson system. These samples were collected in conjunction with the sediment sampling program (Project 2.3). The various components of the BENTHIC communities that were collected in June 1981 were sorted into basic categories, weighed and frozen for future chemical analysis. The benthic samples collected in August were preserved in 75% ethanol and retained for future sorting, preparation and analyses.

In 1982/83, the benthic samples collected in 1981 were prepared and analyzed. Results from the biological/chemical analysis will be correlated with the results of the bottom sediment chemistry analysis in a joint report with Dr. T. A. Jackson. This project is directed by Dr. W. F. Warwick, Environment Canada.

4.3.3 Project 2.3 Biogeochemistry of Sediments: Field samples were collected in June and August 1981 in conjunction with Project 2.2. These samples were used in studies which were designed to:

1. determine whether the impoundment had an effect on the methyl mercury production by stimulating the activities of methylating MICROBES; and
2. identify possible diffuse natural secondary accumulations of mercury which might help to account for the mercury problem.

In addition, a number of laboratory experiments were performed between December 1981 and August 1982. One set of experiments was undertaken to determine the effect of the environmental factors on methyl mercury production in ANAEROBIC sediment water systems. Another set of experiments was designed to test the effect of various clay sized minerals and HUMIC matter, and other substances, on the uptake of methyl mercury by trout fry.

Activities in 1982/83 included another short field trip to collect sediments and shoreline materials from five lakes for analysis and for use in experiments. Laboratory work consisted of: analysis of sediments for total and methyl mercury and related parameters; analysis of shoreline vegetation and soils; experiments on methylation and demethylation of mercury by sediment microbes under varying controlled conditions; and experiments on the uptake of mercury by fish in different sediment-water systems.

Preliminary studies of variations in the abundance of methyl mercury and other forms of mercury in sediments, and the accumulation of mercury and other metals by aquatic organisms have shown major differences between Southern Indian Lake and the lakes of Notigi Reservoir. These differences are related to environmental variables affected by impoundment. Preliminary results of experiments have shown marked effects of clay-sized minerals and organic matter on the ability of sedimentary microbes to methylate mercury and in the uptake of methyl mercury by fish. These results have implications for the interpretation of events occurring in Southern Indian Lake, where there is much suspended matter eroded from shoreline material. This project is directed by Dr. T. A. Jackson, Environment Canada.

4.4. Program 3

4.4.1 Project 3.2, Commercial Fish Surveys: This project is part of an ongoing federal departmental program which is not cost-shared under the Agreement. Fish from lakes which are commercially fished are monitored to determine their mercury content and are classified to determine the risk of exceeding the regulatory tolerances of the various countries to which the fish may be marketed. In Canada the allowable tolerance of mercury in fish has been set at 0.5 ppm. In some other countries, such as the United States of America, the allowable tolerance level is 1.0 ppm.

Lake classifications have been assigned to all lakes and species which have been sampled. In Manitoba there are five classifications:

- a. Monitor
- b. Sample Each Shipment
- c. Export
- d. Detain Each Shipment
- e. Closed

Each classification group has a specific interpretation. They range from "no restrictions" on the monitor classification to "these lakes have either been closed by legislative actions or have been recommended for closure by the Department of Fisheries and Oceans" on the Closed classification.

A detailed description of the mercury inspection procedures along with such other information as a listing of the lake classifications is available in a series of books prepared by the Department of Fisheries and Oceans. The most recent book in the series is entitled "1983 Lake Classification, Inspection Procedures, Industry Services, Western Region, Book 9 - February 1983". The designated contact person for Project 3.2 is Mr. Stewart Law, Department of Fisheries and Oceans.

4.4.2 Project 3.3, Fish Surveys and Fish Eating Guide: In the summer of 1981, fish were collected for mercury analysis by the Department of Fisheries and Oceans at five sites on Southern Indian Lake. In the summer of 1982 the same five areas of Southern Indian Lake were fished. Muscle samples were taken from each fish and the length and weight of each fish was recorded. Total mercury content was determined for each specimen.

The major inferences from these findings are:

1. Mercury levels in major fish species in the South Indian area continue to be elevated above pre-impoundment levels;
2. All samples of PISCIVOROUS fish exceed the Department of Fisheries and Oceans standard of 0.5 ppm for commercial sale in Canada; and
3. Comparison of 1982 results with 1978-81 results indicates a continuing trend of decreasing mercury levels in whitefish, continuing trend of increasing mercury levels in pike, and that mercury levels in walleye have been relatively stable.

It is anticipated that in the 1983 field season both the federal Department of Fisheries and Oceans and the provincial Department of Natural Resources will continue collecting fish for mercury analysis under the Agreement. This project is directed by Dr. R. A. Bodaly, Department of Fisheries and Oceans and Dr. J. O'Connor, Department of Natural Resources.

4.4.3 Project 3.4, Mercury in Hair of Native People: This project which is not cost-shared under the Agreement, is directed towards obtaining information on the mercury levels of the people of the Churchill River Diversion area. The number of people sampled and the frequency of sampling are determined by the appropriate federal or provincial department of health, in cooperation with the people of each community.

The Provincial Department of Health did not undertake a mercury sampling program of the people of the Churchill River Diversion area in 1982. However they did conduct a program in 1981 on the non-treaty residents of Norway House, Cross Lake, South Indian Lake, Nelson House and Split Lake. Health and Welfare Canada did the sampling for the provincial Department of Health on the non-treaty residents in York Landing. Each individual tested was advised of his or her results.

The results of the Manitoba Department of Health's survey were that the majority of the mercury levels of the people sampled were within the normal range of 0-6 ppm for hair samples (See Appendix B).

Those people with mercury levels of 6 to 30 ppm were advised that no one in Canada with such levels has shown any signs of illness due to mercury. However they were advised to eat less of the fish that may have high mercury levels (e.g. pickerel). If an individual's mercury level is greater than 30 ppm, the provincial Department of Health arranges for them to be further tested, as well as advised about eating fish. Again to be on the safe side, the department advises that pregnant women should discuss with their doctors the need to be tested early in pregnancy.

Health and Welfare Canada undertook a mercury analysis program from June 1981 to June 1982 in the six northern communities of Cross Lake, Nelson House, Norway House, South Indian Lake, Split Lake and York Landing. Mercury in hair analysis was offered to 100 percent of each community population on a voluntary basis; that is, any status Indian in these communities could be tested if he or she wished. Pre-natal and maternal cord sampling at delivery was also offered on a voluntary basis for mercury in blood analysis. Neurological testing would automatically be done on any individual if their hair/blood mercury level exceeded 200 ppb. Also the need for neurological testing is assessed on an individual basis by a medical officer where a mercury level exceeds 50 ppb.

Each individual who was tested was advised of the results of his or her mercury testing. The majority of the results were in the normal range of 0-20 ppb for blood analysis (See Appendix B).

Health and Welfare Canada also conducted a mercury testing program in these communities in 1976, 1978 and 1979/80. The majority of these results were also in the normal range of 0-20 ppb (blood analysis).

A summary of the results of Health and Welfare Canada's program of mercury testing in these communities in 1976, 1978, 1979/80 and 1981/82 appears in Appendix B. The designated contact people for Project 3.4 are Dr. L. Richards, Health and Welfare Canada and Dr. P. Warner, Manitoba Department of Health.

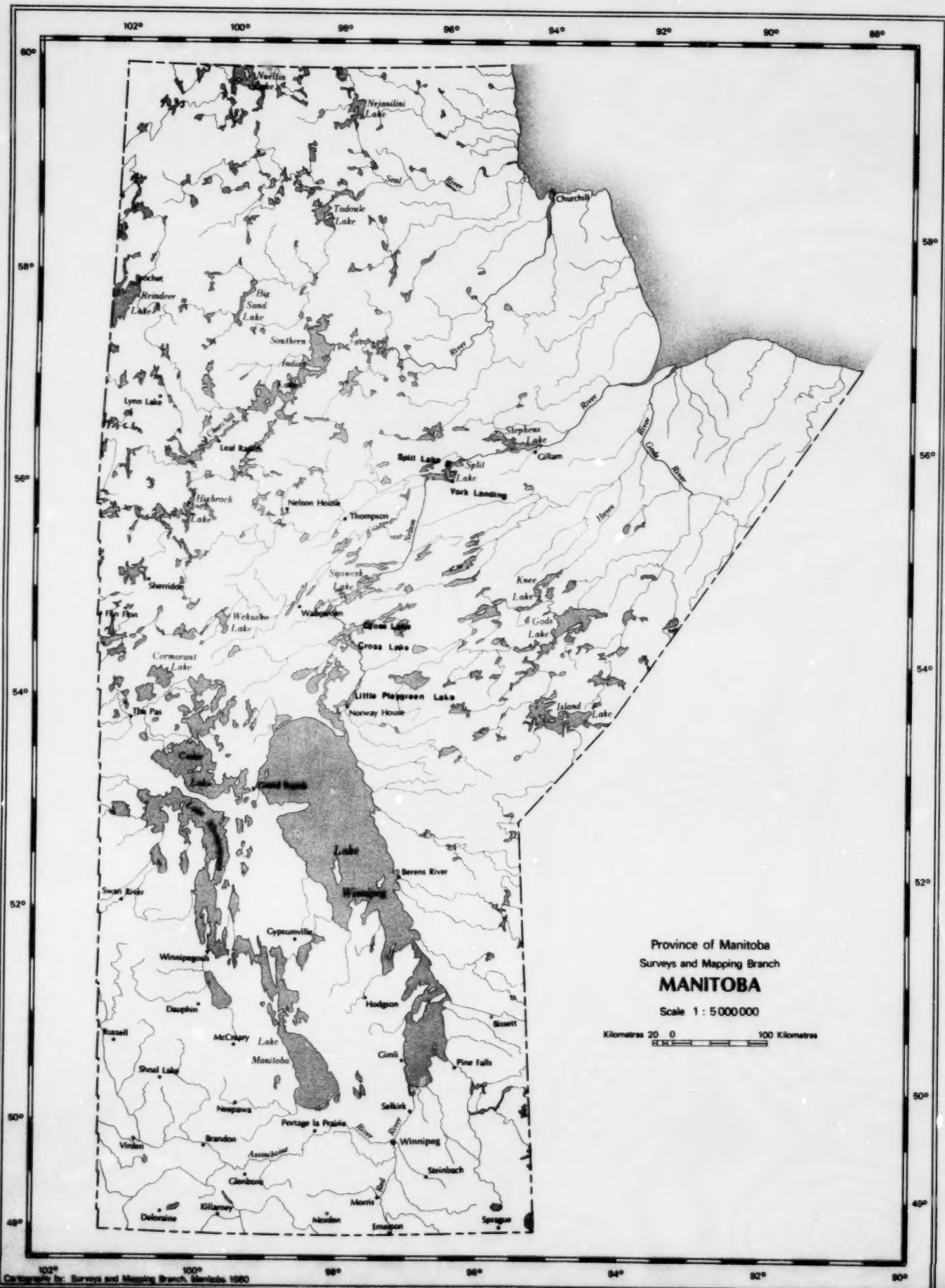
4.5 Program 4

Two of the projects in program 4 were scheduled to begin in 1982/83, Projects 4.1, Public Awareness and 4.2, Study Coordination and Management.

When the Agreement was signed on March 10, 1983 a new release was issued. That was the only activity under Project 4.1 in 1982/83.

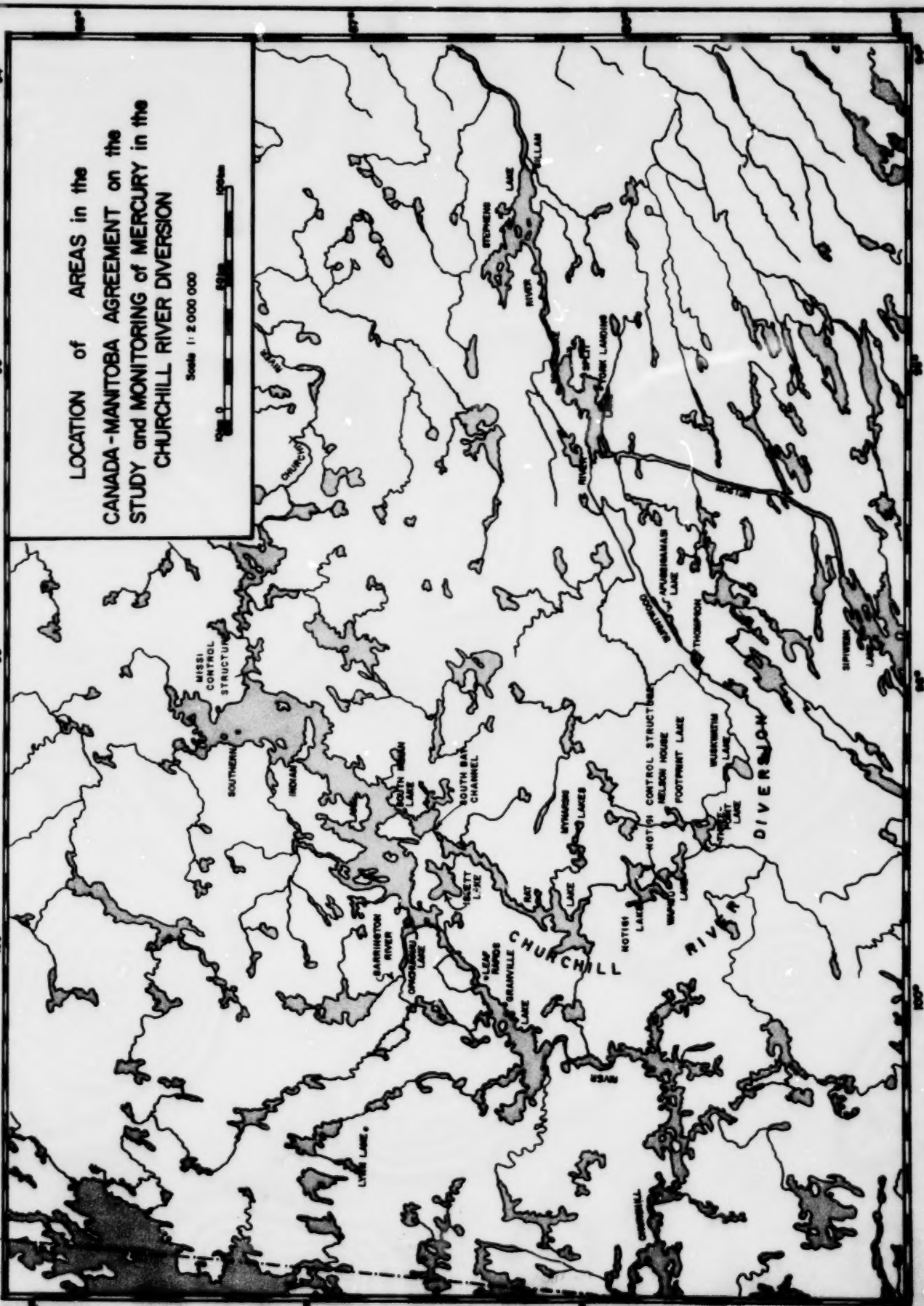
As noted in Section 2.2 of this annual report, arrangements are well under way to begin interviewing for the position of Study Director (Project 4.2). It is anticipated that this position will be staffed early in the next fiscal year.

APPENDIX A



LOCATION of AREAS in the
CANADA-MANTOBA AGREEMENT on the
STUDY and MONITORING of MERCURY in the
CHURCHILL RIVER DIVERSION

Scale 1: 2 000 000



APPENDIX B

MERCURY IN HAIR OF NATIVE PEOPLE

Table B-1: Manitoba Department of Health, Mercury Sampling Program
of Six Northern Manitoba Communities,
1981

Community	Population (Est.)	# Sampled	% Sampled	Results
Norway House	600	153	25.5%	0-6 ppm 151 6-30 ppm 2 (1.3%)
Cross Lake	235	67	28.5%	0-6 ppm 67
South Indian Lake	183	115	62.8%	0-6 ppm 90 6-30 ppm 25 (21.7%)
Split Lake	45	32	71.1%	0-6 ppm 13 No result 19
Nelson House	90	43	47.7%	0-6 ppm 43
York Landing	10	6	60.0%	0-6 ppm 5 6-30 ppm 1 (16.6%)
TOTAL	1163	416	35.7%	6-30 ppm 28 (6.7%)

Table B-2: Health and Welfare Canada, Mercury Testing Program
In Six Northern Manitoba Communities,
1976, 1978, 1979/80

1976

Area	Total # Samples	0-20 ppb	20-100 ppb	100+ ppb
Cross Lake	91	79 - 87%	12 - 13%	
Nelson House	54	52 - 96%	2 - 4%	
Norway House	97	89 - 92%	8 - 8%	
South Indian Lake	49	39 - 80%	10 - 20%	
Split Lake	43	39 - 91%	4 - 9%	
York Landing	25	18 - 72%	7 - 28%	

1978

<u>Area</u>	<u>Total # Samples</u>	<u>0-20 ppb</u>	<u>20-100 ppb</u>	<u>100+ ppb</u>
Nelson House	25	7 - 28%	17 - 68%	1 - 4%

1979/80

<u>Area</u>	<u>Mth.</u>	<u>Yr.</u>	<u>Total #</u>	<u>0-20 ppb</u>	<u>20-100 ppb</u>	<u>100+ ppb</u>
	<u>of Testing</u>		<u>Samples</u>			
Cross Lake	2	80	69	59 - 86%	10 - 14%	
Nelson House	1	79	132	74 - 56%	58 - 44%	
Norway House	1	80	62	57 - 92%	5 - 8%	
South Indian Lake	11	79	103	26 - 25%	71 - 69%	6 - 6%
Split Lake (2)	1	79,80	221	184 - 83%	37 - 17%	
York Landing	1	79	73	57 - 78%	16 - 22%	

Table B-3: Health and Welfare Canada, Mercury Monitoring Program
in Six Northern Manitoba Communities,
June 30, 1981 - June 30, 1982

<u>Communities</u>	<u>Total No.</u>		<u>Ranges</u>		
	<u>Samples</u>		<u>0-20 ppb</u>	<u>20+- 100 ppb</u>	<u>Over 50 ppb</u>
Cross Lake	Hair	420	389 (93%)	31 (7%)	2
	Blood	65	65 (100%)		
Nelson House	Hair	30	26 (87%)	4 (13%)	
	Blood	28	27 (96%)	1 (4%)	
Norway House	Hair	175	166 (95%)	9 (5%)	
	Blood	83	83 (100%)		
South Indian Lake	Hair	514	358 (70%)	156 (30%)	7
	Blood	70	59 (84%)	11 (16%)	1
Split Lake	Hair	385	333 (86%)	52 (14%)	4
	Blood	27	27 (100%)		
York Landing	Hair	180	165 (92%)	15 (8%)	1
	Blood	0*			
TOTAL					
	Hair	1704			
	Blood	273			

* There were only 3 births in this community for the sampling period
and no blood samples were taken.

NOTE: There were no mercury levels over 100 ppb.

Conversion:	20 ppb (blood analysis)	=	6 ppm (hair analysis)
	50 ppb	=	15 ppm
	100 ppb	=	30 ppm
	ppb = parts per billion		ppm = parts per million

APPENDIX C

OTHER MERCURY STUDIES, THE WABIGOON - ENGLISH RIVER SYSTEM

There have been few other studies of mercury in the aquatic environment in Canada. One study which was undertaken was of the mercury pollution in the Wabigoon-English River System in northwestern Ontario. While both the cause and the magnitude of the mercury problem in this system is quite different from those of the Churchill River Diversion, many of the mercury research activities used in the Wabigoon-English River System study are being applied to the Churchill River Diversion study.

The following material is extracted from a progress report issued in 1980 entitled "Mercury Pollution in the Wabigoon-English River System of Northwestern Ontario, and Possible Remedial Measures; A Progress Report for 1978-79." It is expected that a final report on this work will be available in the fiscal year 1983/84.

The Wabigoon-English River system has the dubious distinction of being part of one of the most severely polluted waterways of Canada. Spilling out of Wabigoon Lake in Northwestern Ontario, the Wabigoon River flows through the Town of Dryden, widening out about 53 miles further downstream to form Clay Lake, and finally enters Ball Lake, where it becomes one with the English River. The English River in turn, flows through a chain of lakes and finally merges with the Winnipeg River, which empties into the south basin of Lake Winnipeg more than 100 miles west of Dryden.

The principal sources of pollution in the river-lake system are a paper mill and chlor-alkali plant at Dryden. The paper mill has been discharging organic wastes into Wabigoon River since its construction in 1913. From 1962 to 1970 unrestricted quantities of mercury amounting to approximately 9-11 metric tons (about 20,000 lbs) were released into the river. But from 1970 to 1975, under pressure from the Ontario government, the mercury outputs were reduced by waste treatment procedures and in 1975 the use of mercury in the plant was discontinued.

The mercury pollution has had pronounced and far reaching ecological effects, causing fish population throughout the river-lake system from Dryden at least as far downstream as the Manitoba border to have mercury levels well over 0.5 ppm. The mercury pollution has had a serious impact on certain human populations in the region, especially the Ojibway Indians of the Grassy Narrows and White Dog bands. Commercial fishing was banned although sport fishing continued to be permitted. The mercury also posed a threat to the health of the Ojibway people owing to their customary reliance on locally caught fish as a source of protein. Medical surveys conducted between 1971 and 1978 showed that some individuals in both communities had blood mercury levels exceeding 100 ppb.

While different government-employed scientists had been studying the pollution of the river-lake system for several years, the Government of Canada and the Government of Ontario decided in 1978 to undertake a coordinated joint investigation of the problem with the ultimate objective of finding a practical solution. Thus, on June 5, 1978, a one-year cost-shared agreement was reached.

Each of the two governments agreed to contribute \$50,000 to the study, and a team of federal and provincial scientists and technicians was selected for the task. The project was to cover the biogeochemistry and pathways of mercury, an assessment of the sources, distribution, and transport of methyl mercury and other forms of mercury in the system, and an evaluation of possible anti-pollution procedures. A year later the agreement was renewed for one additional year, and \$100,000 was contributed by each government.

GLOSSARY

ANAEROBIC - living or active in the absence of free oxygen.

ANTHROPOGENIC - involving the impact of man in nature; induced or altered by the presence and activities of man.

BENTHIC - pertaining to, or relating to **BENTHOS**.

BENTHOS - **ORGANISMS** that live on or in the bottom of bodies of water.

BIOACCUMULATION - the increasing concentration of a substance (e.g. mercury) up the food chain (e.g. from invertebrates, such as **ZOOPLANKTON**, to fish to people).

BIOTA - the animal and plant life of a region.

ECOLOGY - a branch of science concerned with the interrelationship of **ORGANISMS** and their environment especially as manifested by natural cycles and rhythms, community development and structure, interaction between different kinds of **ORGANISMS**, geographic distribution, and population alterations.

ECOSYSTEM - an ecological community considered together with the nonliving factors of the environment as a unit.

FORAGE - food that wild or domestic animals take for themselves.

HUMIC - relating to or composed at least in part of organic matter.

LIMNOCORRALS - enclosed experimental **ECOSYSTEMS** which are submerged and anchored in a body of water. The limnocorrals used in Project 2.1 were approximately 10 meters in diameter and 3-4 meters deep.

LIMNOLOGICAL - see **LIMNOLOGY**

LIMNOLOGY - the scientific study of the physical, chemical, and biological conditions of fresh water, especially ponds and lakes.

MERCURIALS - of, relating to, containing, or consisting of mercury.

METHYLATED - see **METHYLATION**

METHYLATION - conversion of one type of chemical compound into another by the addition or incorporation of the methyl group (CH_3 -) e.g. conversion of inorganic mercury to **METHYL-MERCURY**.

METHYL-MERCURY - an organic form of mercury which has a high affinity for animal tissue and is concentrated up the food chain.

MICROBE - a very minute ORGANISM

ORGANISM - a living being

PISCIVOROUS - feeding on fishes.

PLANKTON - the passively floating or weakly swimming animal and plant life of a body of water consisting chiefly of minute plants and of minute animals that have only weak powers of locomotion.

PREDATORY - living by killing and eating other animals.

SUBSTRATE - nutrient medium for bacteria.

ZOOPLANKTON - animal life of the PLANKTON

ANAÉROBIE - qui vit ou se développe en l'absence d'oxygène.

ANTHROPOGÈNE - provoqué par l'action de l'homme sur la nature; causé ou altéré par la présence et les activités de l'homme.

BENTHIQUE - relative au BENTHOS.

BENTHOS - ORGANISMES qui vivent sur l'eau ou le sol sousmarin.

BIOACCUMULATION - concentration de plus en plus forte d'une substance (telle que le mercure) dans la chaîne alimentaire (par exemple: qui passe des invertébrés, tels que les ZOOPLANKTONS, aux poissons et ensuite à l'homme).

BIOTE - la faune et la flore d'une région.

ÉCOLOGIE - discipline scientifique qui s'intéresse aux rapports entre les organismes et leur milieu naturel, et particulièrement aux cycles et rythmes naturels, au développement de communautés et de structures, aux rapports qui s'établissent entre différentes sortes d'ORGANISMES, à la distribution géographique et aux changements de population.

ÉCOSYSTÈME - unité écologique naturelle se composant de parties vivantes et de parties inertes.

ENCLOS D'ÉTUDES LIMNOLOGIQUES - il s'agit d'écosystèmes expérimentaux fermés et submergés dans une pièce d'eau où ils sont ancrés. Ceux utilisés dans le cadre du projet 2.1 mesuraient environ 3 à 4 mètres de haut et 8 mètres de diamètre.

PÂTURE - aliments dont se nourrissent les bêtes sauvages et domestiques.

HUMIQUE - relatif à l'humus, ou se composant, en partie au moins, de matières organiques.

LIMNOLOGIQUE - relatif à la limnologie. Voir limnologie.

LIMNOLOGIE - étude scientifique des conditions physiques, chimiques, météorologiques et biologiques des eaux douces, en particulier les eaux d'étangs et de lacs.

MERCURIEL - relatif au mercure; qui contient du mercure ou se compose de mercure.

MÉTHYLÉ - voir MÉTHYLATION.

MÉTHYLATION - conversion d'un type de composé chimique en un autre par l'addition ou l'incorporation du groupe CH_3 - (méthyles) - par exemple: conversion de mercure inorganique en méthyl-mercure.

MÉTHYL-MERCURE - forme organique de mercure qui présente de fortes affinités pour le tissu animal et qui s'accumule graduellement dans la chaîne alimentaire.

MICROBE - très petit organisme.
ORGANISME - être vivant.
PISCIVORE - qui se nourrit de poissons.
PLANKTON - formes animales et végétales très petites qui flottent ou se déplacent très lentement d'elles-mêmes dans l'eau.
SUBSTRAT - aliments dont se nourrissent les bactéries.
ZOOPLANKTON - petits animaux qui entre dans la composition du plankton.

POOR

QUALITY

ORIGINAL